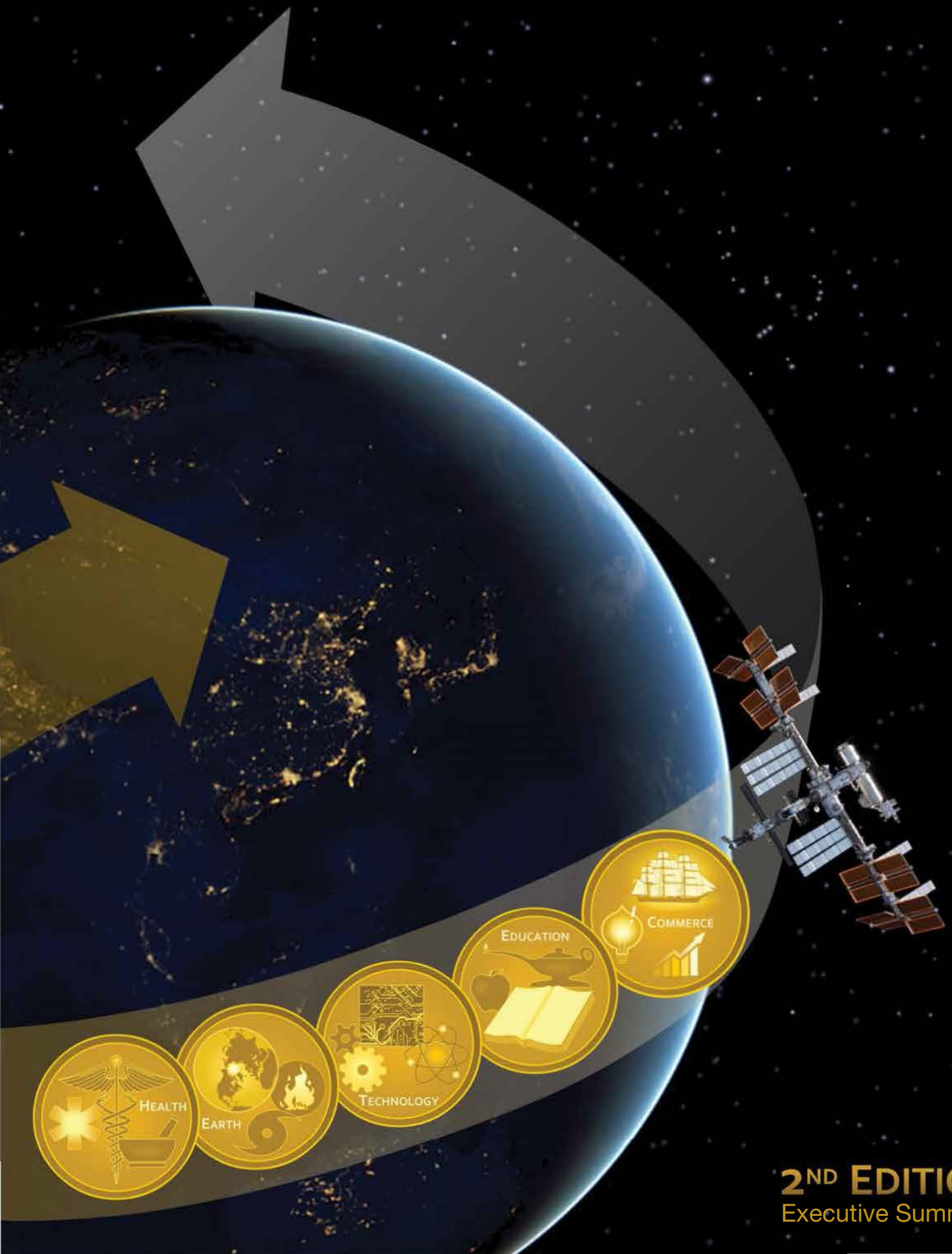
International Space Station

Benefits for Humanity



2nd Edition

Executive Summary

Introduction

Welcome as we share the successes of the International Space Station (ISS) in this second edition of the *International Space Station Benefits for Humanity*. The ISS is a unique scientific platform that has existed since 1998 and has enabled over 2,400 researchers in 83 countries and areas to conduct more than 1,700 experiments in microgravity through just September 2014, and the research continues…

Since November 2, 2000, the ISS has maintained a continuous human presence in space. Even before it was habitable, the research began on the only orbiting laboratory of its kind. In 2011, when ISS assembly was complete, the focus shifted to fully utilizing the lab for continued scientific research, technology development, space exploration, commerce, and education.

In the first edition of the book released in 2012, the scientific, technological and educational accomplishments of ISS research that have an impact on life on Earth were summarized through a compilation of stories. The many benefits being realized were primarily in the areas of human health, Earth observations and disaster response, and global education.

This second edition includes updated statistics on the impacts of those benefits as well as new benefits that have developed since the first publication. In addition, two new sections have been added to the book: Economic Development of Space and Innovative Technology.

The ISS is a stepping stone for future space exploration, as the only orbiting multi-disciplinary laboratory of its kind returning research results that develop LEO and improve life on our planet. The goal of this publication is to serve as a source of pride to those who read it and learn of the unique shared laboratory orbiting our planet that provides ground for critical technologies and ways to keep humans healthy in space.

Themes

Human Health

- Health Technology
- Preventing Bone Loss
- Immune Defenses
- Developing New Therapies
- Food and the Environment
- Heart Health and Biorhythms
- Improving Balance and Movement

Earth Observation and Disaster Response

- Environmental Earth Observations
- Disaster Response

Innovative Technology

- Fluids and Clean Water
- Materials
- Satellites
- Transportation Technology
- Robotics

Global Education

- Inquiry-based Learning
- Inspiration

Economic Development of Space

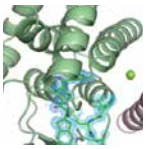
- Commercial Service Providers
- Commercial Research

Book Highlights

Robotic arms lend a healing touch
The world's first robotic technology capable of performing surgery inside magnetic resonance machines makes difficult surgeries easier or impossible surgeries possible.

Improved eye surgery with space hardware
An eye-tracking device allows the tracking of eye position without interfering with a surgeon's work during corrective laser eye surgery.

Bringing space station ultrasound to the ends of the Earth
Small ultrasound units, tele-medicine and remote guidance techniques make medical care more accessible in remote regions.



High-quality protein crystal growth experiment aboard Kibo
Protein crystal growth experiments contribute to the development of medical treatments. JAXA is making positive advancements in research on obstinate diseases through experiments in space.

Earth remote sensing from the space station
ISS contributes to humanity by collecting data on global climate, environmental change, and natural hazards using its unique complement of crew-operated and automated Earth observation payloads.

Advanced ISS technology supports water purification efforts worldwide
At-risk areas can gain access to advanced water filtration and purification systems affording them clean drinking water.

Tomatosphere™: Sowing the seeds of discovery through student science
This award-winning educational project with an estimated 3 million students participating is helping researchers answer questions about growing food in space while teaching students about science, agriculture and nutrition.

Calling cosmonauts from home
Currently aboard the Russian segment of the station are four space investigations that have educational components to inspire future generations of scientists, technologists, engineers and mathematicians.

Commercialization of low-Earth orbit (LEO)
Forward-thinking, agile companies like NanoRacks and UrtheCast believe routine utilization of the unique environment of outer space has come of age, and that at long last ISS is open for business.

Space mice teach us about muscle and bone loss
Biotech and pharmaceutical companies like Amgen use spaceflight to study their drugs and do preclinical work important for FDA approval.

Human Health

Earth Observation and Disaster Response

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International Space Station Benefits for Humanity

2nd Edition

The International Space Station (ISS) is a unique scientific platform that enables researchers from all over the world to put their talents to work on innovative experiments that could not be done anywhere else. Although each space station partner has distinct agency goals for station research, each partner shares a unified goal to extend the resulting knowledge for the betterment of humanity. We may not know yet what will be the most important discovery gained from the space station, but we already have some amazing breakthroughs.

In the areas of human health, innovative technology, education and observations of Earth from space, there are already demonstrated benefits to people back on Earth. Lives have been saved, station-generated images assist with disaster relief, new materials improve products, and education programs inspire future scientists, engineers and space explorers. Some benefits in this updated second edition have expanded in scope. In other cases, new benefits have developed.

Since the publication of the first edition, a new constituency has developed, one that is using the ISS in a totally different fashion—to develop a commercial market in low-Earth orbit. From pharmaceutical companies conducting commercially-funded research on ISS, to private firms offering unique research capabilities and other services, to commercial cargo and crew, the ISS is proving itself to be just as adaptable to new business relationships as it has been for a broad diversity in research disciplines.

This book summarizes the scientific, technological and educational accomplishments of research on the space station that have had and will continue to have an impact to life on Earth. All serve as examples of the space station's potential as a groundbreaking research facility. Through advancing the state of scientific knowledge of our planet, looking after our health, developing advanced technologies and providing a space platform that inspires and educates the science and technology leaders of tomorrow, these benefits will drive the legacy of the space station as its research strengthens economies and enhances the quality of life here on Earth for all people.

For individual Benefits for Humanity stories and videos, and to download entire document:
www.nasa.gov/stationbenefits

The *ISS Benefits for Humanity 2nd Edition* was developed collaboratively by the members of the International Space Station Program Science Forum, which includes the National Aeronautics and Space Administration (NASA), Canadian Space Agency (CSA), European Space Agency (ESA), Japan Aerospace Exploration Agency (JAXA), Russian State Space Corporation (Roscosmos), and the Italian Space Agency (ASI).

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